Space Weather Technical Forecast

Issued on Wednesday, 12 October 2022 at 01:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with two M-class flares observed from the region of AR3112 (Fki/βγ), the largest of these a M3.9 at 11/0842UTC. Both this flare and the weaker M1.5 at 11/1052UTC appeared to have given rise to filament eruptions observed on SDO AIA 304 imagery. These will be analysed once sufficient coronagraph imagery becomes available for a potential Earth-directed component. This region has lengthened during the last 24 hours, but as it approaches the far northwest of the quadrant, accurate analysis is becoming challenging, although it appears to be losing magnetic complexity. The remaining regions all appear to be relatively inactive, although AR3119 has developed a second umbra in the leader portion and has been classified as a Dsi/β. In addition to the two possible eruptions from the region of AR3112, an eruption was observed close to the south-centre disc early on 11 October, but preliminary analysis does not support an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has declined from 450km/s to 350km/s over the last 24 hours as the recent high speed stream has waned to background. Density has been around or below average. Total magnetic field strength has been weak, with the north-south component, Bz consistently, but weakly negative. Phi angle was mainly positive (away from the Sun), but slowly rotated negative by 11/2200UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has been at background levels. High energy electron flux (greater than 2MeV) has been at moderate to high levels, peaking at 4650 pfu at 11/1730UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout. The 11/2100 UTC observation was 1.99e8 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be Low to Moderate with only a very slight chance of X-class flares, mainly due to the continued influence of AR3112 in the flare probabilities.

Solar Wind / Geomagnetic Activity: A CME may glance the Earth early on 12 October, with a further glancing blow possible on 14 October, but both these are low confidence. The high speed stream from coronal hole 31 has now waned to background, with a weak connection to coronal hole 32 possible during 14 October, giving estimated speeds of 500km/s. Geomagnetic activity is forecast to be mainly Quiet to Unsettled on 12 October, with a slight chance of Active to G1/Minor Storms due to the possible CME. Mainly Quiet through 13 October, then possible further G1/Minor Storms on 14 October due to either a CME glancing blow or high speed stream connection, or even a possible combination of both.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background, but with a daily slight chance of rising in response to any large flares, with a large region in the northwest quadrant. The high energy electron flux (greater than 2 MeV) is likely to persist at mainly moderate to high levels. The associated electron fluence is forecast to persist at Active levels, in the absence of significant CME effects.

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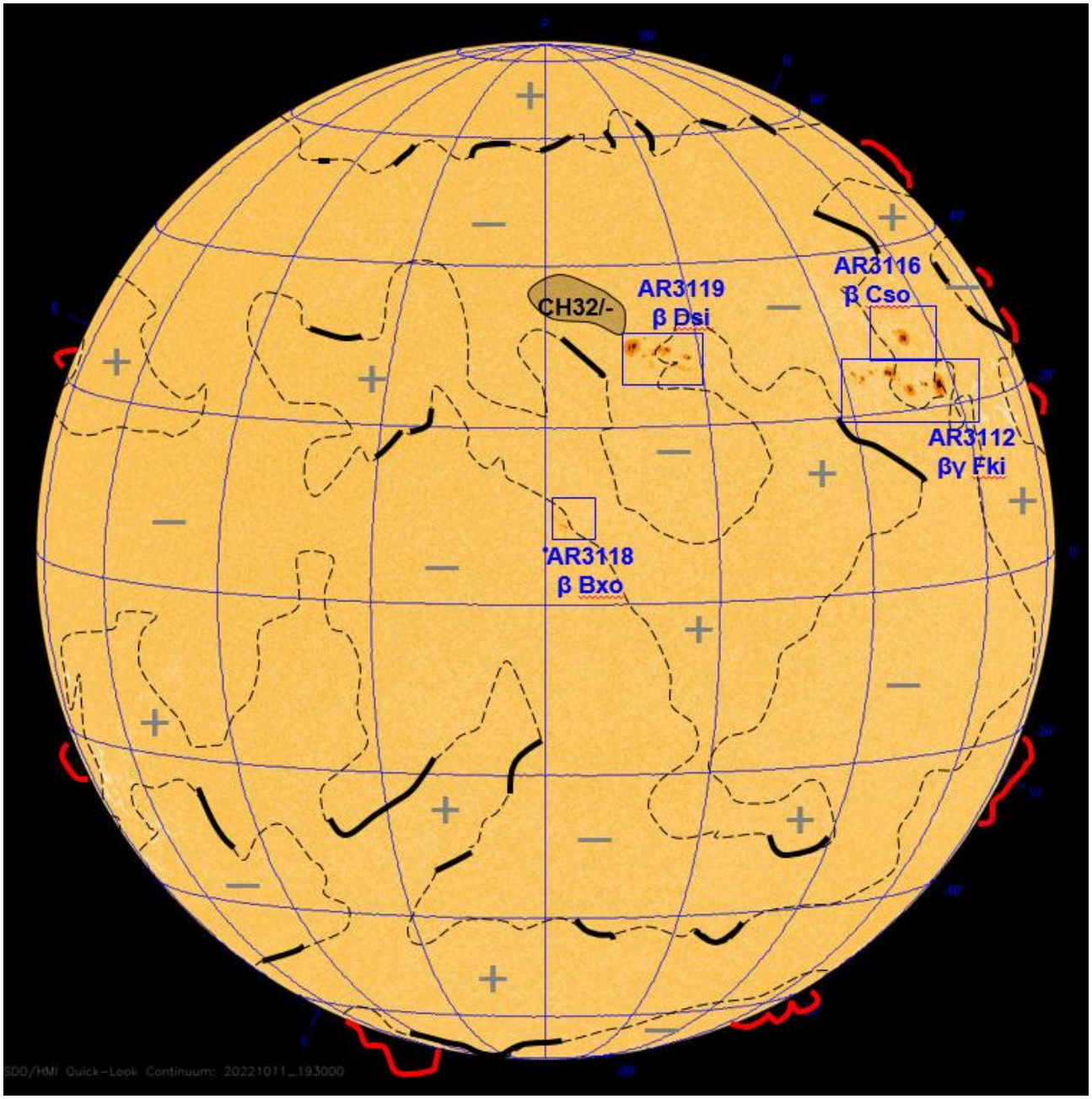
Figure 1. Solar Analysis Valid 11/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption from 07 October may glance the Earth early on 12 October, but with low confidence. A filament eruption from 09 October may then glance the Earth on 14 October based on a provisional assessment. Two M-class flares early on 11 October also appear to have given rise to potentially earth directed CMEs, based on analysis of SDO AIA 304 imagery, but further coronagraph imagery is required to undertake sufficient assessment.

High speed stream effects from coronal hole 31 are continuing to wane, with background speeds developing by early on 12 October in the absence of CME arrivals. The high speed stream from coronal hole 32 may then connect with the Earth on 14 October, based on an estimated speed of 500km/s. However given that the hole is negative polarity, geomagnetic activity is likely to be limited.

Geomagnetic activity is expected to be mainly Quiet to Unsettled on 12 October with a slight chance of Active to G1/Minor Storms from a potential CME arrival. Mainly Quiet on 13 October and much of 14 October prior to a possible CME glancing blow and connection to coronal hole 32. Residual effects on 15 October are dependent on the possible strength of any CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1715	Partial	Filament	NW quadrant	370km/s	12/0000UTC +/- 8 hours	Weak, low confidence glancing blow.

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Figure 2: MOSWOC Enlil showing potential arrival time of CME, embedded in the high speed stream.

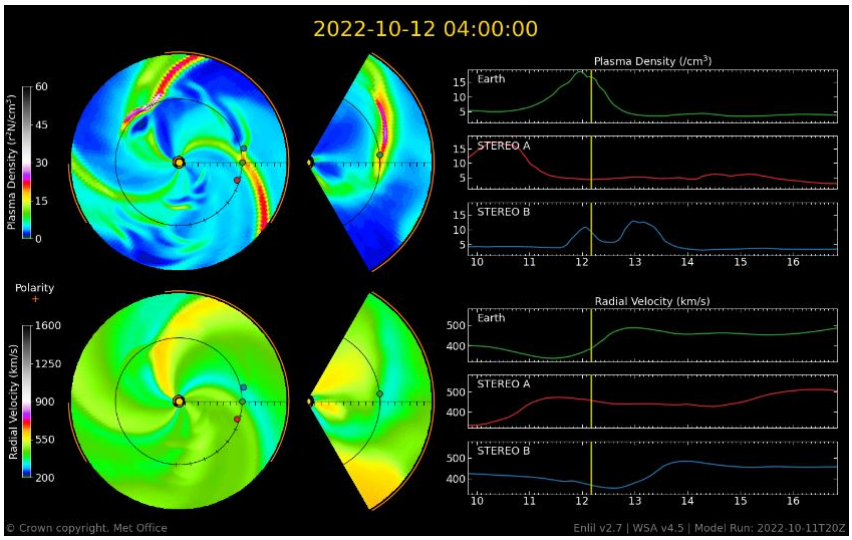
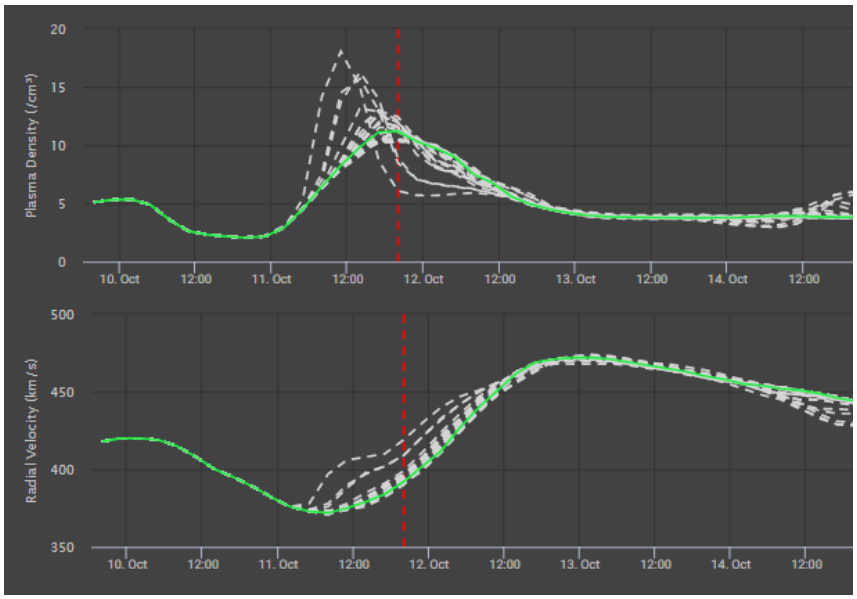


Figure 3: MOSWOC Enlil ensemble, demonstrating reason behind range in potential arrival time.



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Radio Blackouts - X-Ray Flares:
There are four sunspot regions on the disc, with AR3112 the most prominent feature in the northwest quadrant and the source of two M-class flares in the last 24 hours, which appear to have given rise to two filament eruptions. This region is expected to continue to influence solar activity through the next four days, with no evidence of significant fading in visible or magnetic structure.

The remaining regions have not shown any elevated activity, but will continue to be monitored. There are also a number of bright regions on the far side, which will rotate onto the disc through the forecast period. Based on recent history the risk of further M-class flaring has been increased to 60%.
Solar activity is likely to be mainly Low to Moderate.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: GOES 16 x-ray flux for the last 24 hours, with the two M-class flares clearly discernible

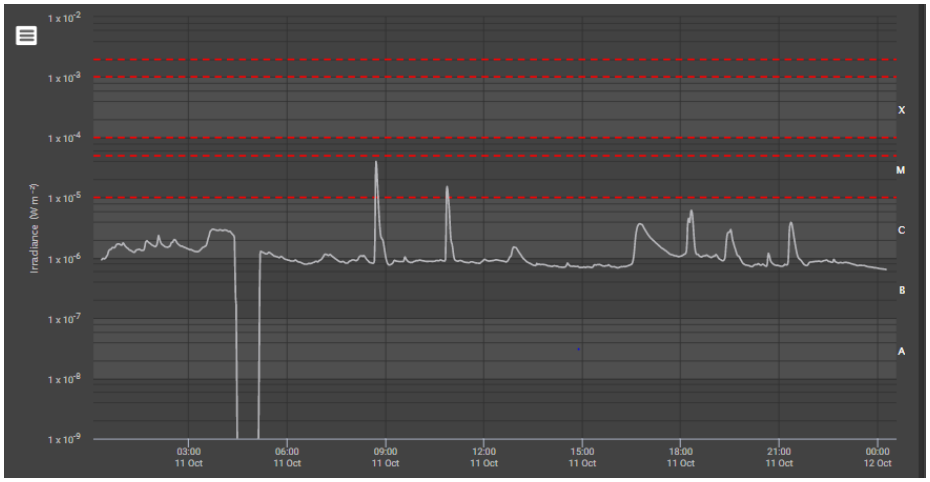

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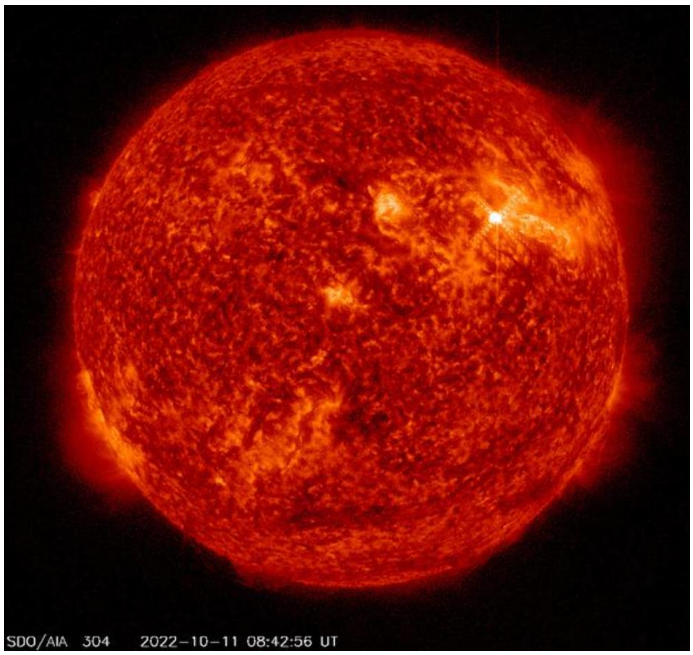
Figure 5: SDO AIA 304 imagery at time of first M-class flare.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES16 is currently at Background levels.

There has been a recent increase in flare activity from AR3112, with two recent M-class flares. Given their location, complexity and westward advance, there is a slight chance of seeing an S1 event. Any arriving eastern horizon regions are thought unlikely to contribute significantly to proton storms through the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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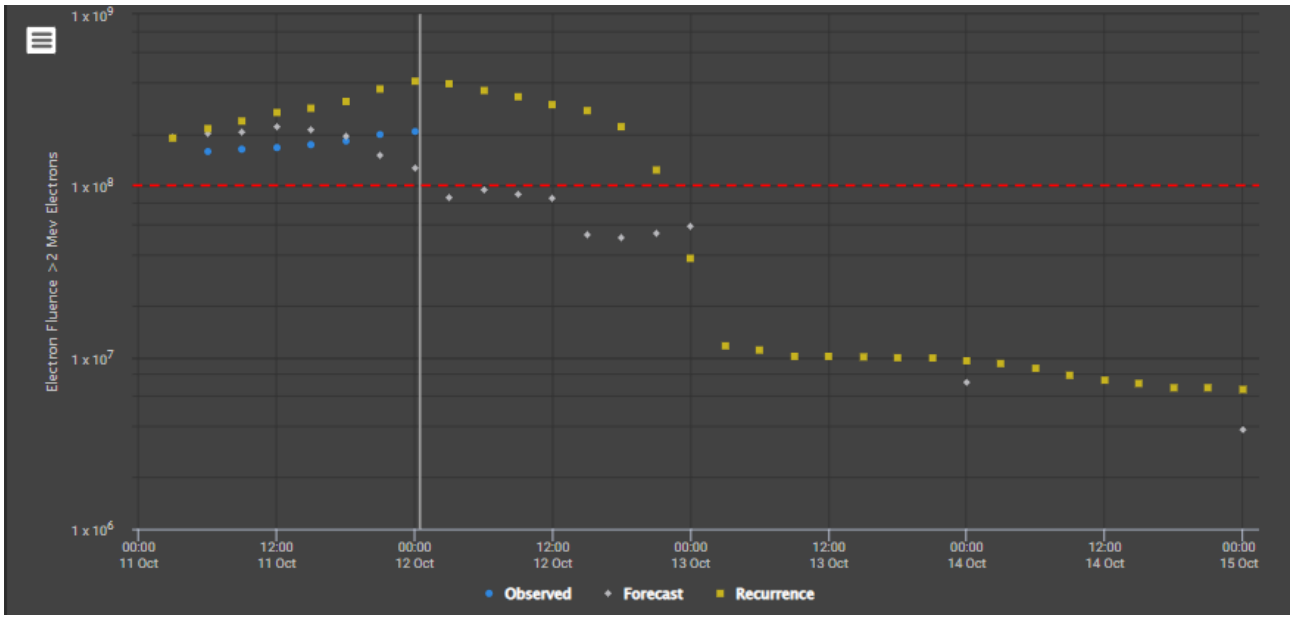
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES 16 is currently high (1e3 pfu) and is likely to remain at mainly high levels on 12 October as the recent coronal hole high speed stream begins to wane. The diurnal peaks of the flux are then expected to reduce through the forecast period, and increasingly vary between moderate and high levels, but any increased geomagnetic activity could briefly inhibit electron flux within the radiation belts.
Fluence is currently above the Active (1e8 integrated pfu) threshold and is likely to continue above through the next four days, with limited potential for significant reductions in electron values.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	80	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 6: MOSWOC REFM electron fluence model, forecast trend is expected to be above that shown by the model.



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